Summary of ICCR Source Work Group Meeting
February 26, 1998
Internal Combustion Engines Work Group Meeting

I. Purpose

The main objectives of the meeting were the following:

- Work Group consensus on additional items to finalize population subgroup's work on the preliminary MACT floor
- Work Group consensus on additional items (other than Population) to address in the preliminary MACT floor analysis
- Work Group consensus on approach to above-the-floor MACT
- Identification of remaining testing issues

II. Location and Date

The meeting was organized by the Environmental Protection Agency (EPA) and was held at the Adam's Mark Hotel in Winston-Salem, NC. The meeting took place on February 26, 1998.

III. Attendees

Meeting attendees included representatives of the OAQPS Emission Standards Division, trade associations, universities, and state agencies. A complete list of attendees, with their affiliations, is included as Attachment I.

IV. Summary of Meeting

The meeting consisted of discussions between WG members on selected issues which are listed below. The order of the meeting followed the agenda provided in Attachment II. A bullet point summary of the meeting is presented as Attachment III.

The topics of discussion included the following:

- Report on CC Meeting
- Report and WG discussion on pollution prevention
- Presentation and discussion of Population Subgroup's findings on the preliminary MACT floor
- WG Discussion of other MACT floor issues
- Report and WG discussion on "Other Fuels"
- Update on testing issues and schedule
- Report from the Next Steps Ad-Hoc Group on Above-the-floor MACT and WG Discussion of next steps

- Next Meeting Issues

Report on CC Meeting

Vick Newsom gave a brief synopsis of the February 24-25 CC Meeting. A copy of the CC Meeting flash minutes is available on the TTN. The following points were accented:

- The issue of the requirement for a numerical emission limit for cases where there are no add-on controls for all source WGs is still being discussed.
- Engines Test Plan will move forward with the consent of the CC.
- Dates for future CC Meetings:

April 28-29	Fort Collins, CO
July 28-29	Long Beach, CA
Sept 15-16	RTP, NC
Dec 15-16	Houston, TX.

Report and WG Discussion on Pollution Prevention

Sam Clowney made a presentation on Pollution Prevention, as a representative of the Pollution Prevention Subgroup of the CC. This is included as Attachment IV. The general discussion included the following topics:

- To address the issue of Pollution Prevention, the CC requires that each WG consider Good Combustion Practices (GCPs). These were provided in a handout, but no electronic copy is available. For a copy of this document, contact Linda Coerr at 919-932-3190.
- Good combustion practices will not apply to all engines in all situations. In general, for efficiency purposes, most engines are operated within OEM (Original Equipment Manufacturer) specifications.
- GCPs in the past have been related to NOx reduction, and it is not known whether having GCPs will reduce HAPs. Although there is no data correlating GCPs with HAPs, intuitively, following OEM specifications will minimize emissions.
- Engines operated in attainment areas will differ from those in non-attainment areas.
- The Engine WG should focus on engine maintenance, rather than issues like air to fuel ratio or timing.
- State agencies use CO detectors to check for good combustion for engines. Don Price will provide the group with examples of what state regulatory agencies require from engine operators regarding good operating practices.
- A new ad hoc group was formed to address the issue of GCPs. This will be headed by Don Dowdall, and will include Bill Heater, Jay Martin, Don Price, and Sam Clowney as members. Their goal is to provide a white paper to the CC regarding these issues.

Presentation and Discussion of Population Subgroup's Findings on the Preliminary MACT Floor

Wayne Hamilton made a brief presentation on the status of the Population Subgroup, regarding a preliminary MACT floor. His presentation is included as Attachment V. The following points of discussion ensued:

Preliminary MACT Floor

- Wayne Hamilton presented a preliminary MACT floor as no controls for every subcategory except Natural Gas Fired 4 Stroke Rich Burn engines, which have a MACT floor of "Catalytic Reduction," more specifically, NSCR.
- The RICE WG has come to a consensus on the preliminary MACT floor developed by the Population Subgroup, with some stipulations from INGAA.
- The Population Subgroup will provide a draft presentation for the CC regarding a preliminary MACT floor for RICE, with some additional slides on emission control technologies provided by the Emissions Subgroup.

INGAA Concerns with Population Database

- INGAA raised concerns about the integrity of the database, and provided a handout raising their concerns. This handout is included as Attachment VI. Their original request was that this handout be included with all presentations of MACT floor and database issues. This caveat, as is, was not accepted by the WG. Amanda Agnew and Sam Clowney will discuss this issue further.
- Vick Newsom mentioned that Fred Porter announced during the CC meeting that EPA will make no further revisions to the Population Database.
- Jay Martin proposed that the EPA tell the CC during the presentation that this is not a chance to critique the database, especially without providing a suitable alternative.

Further Subcategorization of 4 Stroke Rich Burn Engines by HP

- Regarding the subcategorization of 4 stroke rich burn engines based on HP presented by Wayne Hamilton, it was pointed out that small engines are most likely under-represented by the RICE Population Database.

- The database primarily includes engines which require state and local agency permits, and typically excludes smaller engines.
- Vick Newsom pointed out that in Texas and Louisiana, engines with less than 500 HP typically have no controls, and engines less than 240 HP are typically not registered with the state.
- Mike Horowitz stated the need for documentation to this effect.
- It was decided that the WG would determine if a HP cutoff for 4SRB engines is appropriate at a later date.
- Wayne Hamilton is resigning as member of the RICE WG, so he will no longer be able to lead the Population Subgroup. He nominated Mike Milliet to replace his role as head of Population Subgroup.

Representativeness of the Database

- The database was compared with several other industry databases, and by comparison, is representative of industry for the purposes of developing a MACT floor.
- Darrell Bowen said he had never heard of a 4 stroke rich burn engine with catalytic reduction, and wondered if the data was skewed. It was confirmed by several WG members that they do exist.
- Mike Horowitz stated that the RICE database is one of the more complete databases he has seen on which a MACT floor will be based. He sees no statistical skew, since the engines which are represented in the 2/4 stroke, rich/lean burn subcategorization are located in Wyoming, Colorado, Connecticut and New Mexico. If these states included California or Texas, this may have exhibited a skew.

Other Fuels

- More work needs to be performed regarding other fuels. On the subcategorization chart, it was requested that landfill/digester gas be subcategorized separately, and all other fuels be left in the spark ignition category.
- Alpha-Gamma will provide the Other Fuels subgroup information on facilities that reference crude oil fired engines with catalytic control.
- Alpha-Gamma will follow up on AMSA data which includes data on digester gas fired engines.
- Amanda Agnew will look into the possibility of Landfill MACT covering landfill gas fired engines.

WG Discussion of Other MACT Floor Issues

- The issue of emphasizing a required numerical emission limit

for situations with no add-on controls is still being discussed. "Achievability" is the issue in focus.

Report and WG Discussion on "Other Fuels"

Ed Torres made a brief presentation on the progress of the Other Fuels Subgroup, which is included as Attachment VII. The discussion which followed included the following points:

- The landfill gas fired engines which show catalytic reduction as a control device in the Population Database are no longer in operation.
- Ed Torres proposed that landfill gas fired engines be regulated under the Landfill MACT, along with the other sources currently included in the ICCR effort. Amanda Agnew will research this further.
- At this time the RICE WG will focus its attention on the fuels that cover 95% of the engine population shown in the RICE Population Database; this includes diesel and natural gas fired engines. Other fuels will still be subcategorized.
- Rand Drake pointed out that the Department of Defense characterizes kerosene and jet fuel as refined diesel fuel.

Update on Testing Issues and Schedule

Bryan Willson made a presentation on the Schedule for Testing and other Testing Issues. This is included as Attachment VIII. Terry Harrison also made a brief presentation on the testing contractor. This presentation is included as Attachment IX. Major points included the following:

- All engines for testing should be in Denver by April 1, 1998. This includes the 4 stroke diesel 3508 Caterpillar, the 4 stroke lean burn Waukesha, the 4 stroke rich burn White Superior, and the 2 stroke lean burn Cooper Bessemer, which is already on site.
- In order to obtain catalysts for testing, a request for proposal was sent to 5 catalyst manufacturers. No positive responses have been received to date.
- The schedule/timeline that was developed by the Testing Subgroup for testing was presented. This was not developed by the testing contractor.
- The catalyst should be chosen based on the representativeness of it in the field, the vendor having catalyst expertise, and at best, all catalysts should be provided by one manufacturer.
- Testing will begin in July, 1998. This is based on 100 hours of catalyst aging.
- Pacific Environmental Services (PES) will be the testing

contractor.

- Terry Harrison pointed out that there is the possibility of a budget shortfall, since the proposed budget did not consider:
  *obtaining/installing catalyst $28K
  *catalyst aging $88K
  *ship and decom engines $7K
  *extend test site/equipment $42.5K.
  EPA may commit more money to testing or may scale down the testing effort. Alternatively, stakeholders can fund certain tasks, although EPA will not solicit funds for doing so.
- Sam Clowney indicated that the gas industry would like to keep the test program as a whole, so PRC International/Gas Research Institute will support the testing effort if needed.

Report from the Next Steps Ad-Hoc Group on Above-the-Floor MACT and WG Discussion of Next Steps

Sam Clowney provided two handouts regarding next steps for Above-the-Floor MACT. These are provided as Attachment X.

- Model Engines were developed during this meeting by marking up the Model Turbines developed by the Combustion Turbines Work Group.

Next Meeting Issues

- The next meeting will be held on Friday, April 3, 1998. Its location will be announced at a later date. It will focus on the presentation of the preliminary MACT floor to the CC on April 28-29, 1998 in Fort Collins, Colorado.
- The following meeting will be in Fort Collins, Colorado, following the CC Meeting, on April 30, 1998. It will be held at the Engine and Energy Conversion Laboratory, where engine testing will be performed. This meeting is scheduled from 8 a.m. to 3 p.m., and will include a tour of the engine testing facility.

These minutes represent an accurate description of matters discussed and conclusions reached and include a copy of all reports received, issued or approved at the February 26, 1998 meeting of the Reciprocating Internal Combustion Engines WG. Amanda Agnew

ATTACHMENT I

LIST OF ATTENDEES

Stationary Internal Combustion Engines Work Group Meeting
Winston-Salem, NC
February 26, 1998
List of Attendees

Amanda Agnew	EPA OAQPS Emissions Standards Division
Darrell Bowen	CNG Transmission Corporation
Michael Brand	Cummins Engine Company, Inc.
Sam Clowney	Tenneco Energy
Donald Dowdall	Engine Manufacturers Association
Rand Drake	U.S. Naval Facilities Engineering Service Center
Charles Elder	General Motors Corporation
Wayne Hamilton	Shell E&P Technology Company
Bill Heater	Cooper Energy Services
Michael Horowitz	EPA Office of General Counsel
Jay Martin	University of Wisconsin-Madison
Michael Milliet	Texaco E&P Inc.
Vick Newsom	Amoco Production Section
William Passie	Caterpillar, Inc.
Donald Price	Ventura County Air Pollution Control District
Ed Torres	Orange County Sanitation District
Bryan Willson	Colorado State University
Jan Connery	Eastern Research Group
Brahim Richani	Alpha-Gamma Technologies
Jennifer Snyder	Alpha-Gamma Technologies
Ana Alvarez	Alpha-Gamma Technologies
Stan Coerr	Coerr Environmental
Linda Coerr	Coerr Environmental
Tim Hunt	American Petroleum Institute
Terry Harrison	EPA OAQPS Emissions Measurement Center

Brian Quil U.S. Naval Facilities Engineering Service Center

Mahesh Gundappa Radian International

ATTACHMENT II

AGENDA FOR THE FEBRUARY 26, 1998 RICE WG MEETING

Agenda
Reciprocating Internal Combustion Engine Work Group
February 26, 1998 Work Group Meeting
Adam's Mark Hotel, Winston Salem, North Carolina

8:00 – 8:30 Welcome, Meeting Goals (A. Agnew)
Agenda Review (J. Connery)

MEETING GOALS:
1. Work Group Consensus on Additional Items to Finalize Population Subgroup's Work on the Preliminary MACT Floor
2. Work Group Consensus on Additional Items (other than Population) to Address in the Preliminary MACT Floor Analysis
3. Work Group Consensus on Approach to Above-the-Floor MACT
4. Identification of Remaining Testing Issues

8:30 – 9:00 Report on the Coordinating Committee Meeting (V. Newsom)

9:00 – 9:30 Report and Work Group Discussion on Pollution Prevention (S. Clowney - discussion leader)

9:30 -- 9:45 BREAK

9:45 – 10:15 Status of Population Subgroup's Work on the Preliminary MACT Floor (W. Hamilton and Alpha-Gamma)

10:15 – 10:45 Work Group Discussion of Other MACT Floor Issues (A. Agnew - discussion leader)

10:45 – 11:30 Report and Work Group Discussion on "Other Fuels" (E. Torres - discussion leader)

11:30 – 12:00 LUNCH

12:00 – 12:30 Update on Testing Issues & Schedule (B. Wilson, D. Dowdall, & T. Harrison)

12:30 – 1:00 Report from the Next Steps Ad-Hoc Group on Above-the-Floor MACT (S. Clowney - discussion leader)

1:00 – 1:30 Work Group Discussion on Approach for Above-the-Floor MACT

1:30 – 1:45 BREAK

1:45 – 2:15 Work Group Discussion of Next Steps (A. Agnew and S. Clowney)

2:15 - 2:25 Next Meeting: Schedule and Tentative Agenda Items (J. Connery)

2:25 – 2:30 Review of Flash Minutes (J. Snyder)

2:30 ADJOURN

ATTACHMENT III

BULLET POINT SUMMARY

Summary of ICCR Source Work Group Meeting, February 26, 1998
Internal Combustion Engines Work Group Meeting
Adams Mark Hotel, Winston Salem, North Carolina

Decisions

- As soon as Brian Quil's nomination is received, he will be presented to the CC to replace Rand Drake as a member of the RICE WG.
- A new ad hoc group was formed to develop Good Combustion Practices. Don Dowdall will head the group, and members will include Sam Clowney, Jay Martin, Bill Heater, and Don Price.
- The RICE WG has come to a consensus on the preliminary MACT floor developed by the Population Subgroup, with some stipulations from INGAA. The WG will decide if a HP cutoff for 4SRB engines is appropriate at a later date.
- Engines covered under other fuels will be subcategorized by each fuel type.

Next Meeting

- The next meeting will be held on Friday, April 3, 1998. Its location will be announced at a later date. It will focus on the presentation of the preliminary MACT floor to the CC on April 28-29, 1998 in Fort Collins, Colorado.
- The following meeting will be in Fort Collins, Colorado following the CC Meeting, on April 30, 1998. It will be held at the EECL, where engine testing will be performed. This meeting is scheduled for 8 a.m. to 3 p.m., and will include a tour of the engine testing facility.

Action Items

- Alpha-Gamma: Follow up on AMSA data which includes data on digester gas fired engines.
- Alpha-Gamma: Provide subcategories on the subcategory tree chart for Other Fuels.
- Alpha-Gamma: Provide the Other Fuels Subgroup information on facilities that reference crude oil fired engines with catalytic control.
- Population Subgroup: Create presentation on preliminary MACT floor for CC meeting in April.
- Emissions Subgroup: Assist in preliminary MACT floor presentation by providing slides on emission control technologies.
- Amanda Agnew: Check on Landfill MACT possibly covering landfill gas fired engines.
- Don Price: Provide the GCP Ad Hoc Group with examples of what state regulatory agencies require from engine operators regarding good operating practices.

ATTACHMENT IV

POLLUTION PREVENTION PRESENTATION BY SAM CLOWNEY

Pollution Prevention

presented to:

Reciprocating IC Engine Work Group

presented by:

Sam Clowney, Tennessee Gas Pipeline

February 26, 1998

Topics

- Coordinating Committee Recommendations
  - Good Combustion Practices
- P2 Subgroup Work on Other P2 Techniques
  - Operator Training
  - Input or Fuel/Waste Management
  - Output or Energy Management
- Possible Next Steps for IC Engine Work Group

CC Recommendation: GCPs

- Work Groups to consider P2 Subgroup's guidance on Good Combustion Practices (GCPs) in their evaluation of alternative concepts regarding GCPs
- Examples listed indicate range of existing practices
- Examples are not considered applicable to all combustion sources
- Work Groups should evaluate techniques, practices, and possible standard approaches appropriate for subcategories or other subsets of sources

Good Combustion Practices (1)

Recommended for all devices, as applicable

- Operator practices
  - written site-specific operating procedures in accordance with GCPs, including startup, shutdown, malfunction
- Maintenance knowledge
  - equipment maintained by personnel with training specific to equipment
- Maintenance practices
  - site-specific procedures for optimum maintenance practices
  - periodic evaluation, inspection, overhaul as appropriate
- Fuel/waste quality & handling (where appropriate)
  - fuel/waste analysis, if composition could vary & affect HAPs
  - fuel/waste handling procedures applicable to the fuel/waste

Good Combustion Practices (2)

Other GCP concepts - not recommended for IC engines

- Stoichiometric (fuel/air) ratio (open combustion only)
  - SR limits
  - routine & periodic adjustment
  - CO emissions limitation
- Firebox residence time, temperature, turbulence
  (open combustion with supplemental vent streams or incinerators)
- Proper liquid atomization
  (open combustion with liquid fuel/waste)
  - routine & periodic adjustments & checks
  - procedures to ensure adequate atomization & mixing with combustion air

Good Combustion Practices (3)

Other GCP concepts - not recommended for IC engines
(continued)

- Fuel/waste sizing (solid fuel/waste firing)
  - specification appropriate for fuel/waste fired
  - periodic checks
- Combustion air distribution (mainly stoker and solid fuel firing)
  - routine & periodic adjustments & checks
- Fuel/waste dispersion (solid fuel/waste firing)
  - routine & periodic adjustments & checks

Other P2 Techniques

- No final recommendations from P2 Subgroup or CC
  - Draft materials developed for discussion
- Areas of investigation:
  - Operator training
    - » training course, exam, certification of operators
  - Fuel/waste management or input P2
    - » in general, provide incentives to make process changes before fuel is burned to reduce emissions
  - Energy management or output P2
    - » in general, provide incentives to make process changes to more efficiently use energy generated by combustion device

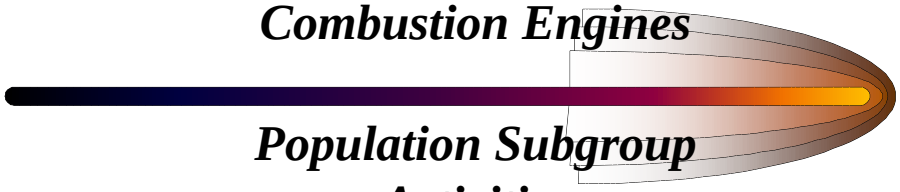
Possible Next Steps for IC Engine Work Group

- Review CC recommendations on Good Combustion Practices that are potentially applicable to IC engines
- Determine whether there are any P2 practices in place at this time for IC engines
- Determine possible regulatory alternatives that may incorporate P2 practices for IC engines

ATTACHMENT V

PRELIMINARY MACT FLOOR PRESENTATION
BY WAYNE HAMILTON

Reciprocating Internal Combustion Engines



Population Subgroup Activities

February 26, 1998
Winston-Salem, NC

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Objectives

- **<u>Presentation Objectives:</u>**
  - Work Activities
  - Database Representation
  - Propose “Preliminary MACT Floor”
  - Control Technologies

2

Work Activities

- Responded to **INGAA's Comments**
- Released **New Database**
- Revised **gasoline fired engines >300 HP** to natural gas fired
- Reviewed and **Updated Engine HP Information**

3

INGAA Comments

- **<u>Included</u>**
  - Additional Database Clean Up
  - Obtain More Database Information

4

Effect of INGAA Comments on MACT Floor

Spark Ignition:

- Previously: 19,176 Undetermined
- Now: 18,666 93.70% No Equipment 4.33% Catalytic Reduction

Spark Ignition Gaseous Fuel:

- Previously: 18,461 93.55% No Equipment 4.42% Catalytic Reduction
- Now: 18,117 93.60% No Equipment 4.41% Catalytic Reduction

Spark Ignition Liquid Fuel Fired Engines:

- Previously: 696 96.14% No Equipment 2.14% Catalytic Reduction
- Now: 656 95.91% No Equipment 2.27% Catalytic Reduction

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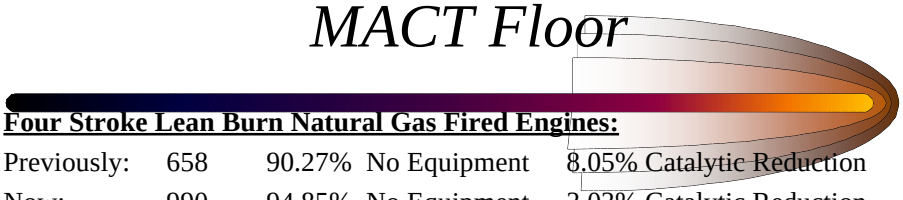
Effect of INGAA Comments on MACT Floor



- **Four Stroke Lean Burn Natural Gas Fired Engines:**
- Previously: 658 90.27% No Equipment 8.05% Catalytic Reduction
- Now: 990 94.85% No Equipment 3.03% Catalytic Reduction

- **Four Stroke Rich Burn Natural Gas Fired Engines:**
- Previously: 878 78.84% No Equipment 18.37% Catalytic Reduction
- Now: 1,535 77.16% No Equipment 19.94% Catalytic Reduction

- **Two Stroke Lean Burn Natural Gas Fired Engines:**
- Previously: 853 98.95% No Equipment 1.05% Nonsense
- Now: 1,237 99.19% No Equipment 0.81% Nonsense

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Effect of INGAA Comments on MACT Floor

- **Compression Ignition:**
- Previously: 9,425 Undetermined
- Now: 9,394 98.27% No Equipment 0.66% Nonsense

- **Compression Ignition Dual Fuel Fired Engines:**
- Previously: 255 95.82% No Equipment 1.67% Gas Scrubber, General 1.26% Steam or Water Injection
- Now: 600 94.44% No Equipment 1.96% Steam or Water Injection

- **Compression Ignition Liquid Fuel Fired Engines:**
- Previously: 9,202 98.38% No Equipment 0.65% Nonsense
- Now: 8,794 98.54% No Equipment 0.64% Nonsense

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Work Activities

- January 98 Database on TTN

- **E-Mailed** Information Packet
  - **Reply INGAA Comments**
  - Subcategorization Chart
  - Impact of INGAA Comments on MACT floor

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Engine HP-Update

- Received comments that gasoline fired engines are **not typically >300 HP**; These were **reassigned** the fuel type **Natural Gas**

- Received comments that Unit **HP field has large values**; No stationary engines are **typically >10,000 HP**
  - Assumed **typographical errors/incorrect units**: these capacities were deleted from the working file
  - When **Make and Model Capacities** were available, these were substituted in for the **capacity field**

- Corrected these two points, **newest version** to be released in the near future

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Engine HP Distribution

- **<u>Natural Gas Fired Engines</u>** (65% populated)
  - 0 - 499 HP: 4413
  - 500 - 999 HP: 3025
  - 1000 - 4999 HP: 3903
  - 5000 - 10000 HP: 241

- **<u>NG 4SRB Engines</u>** (96% populated)
  - 0 - 499 HP: 592
  - 500 - 999 HP: 652
  - 1000 - 4999 HP: 236

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Engine HP Distribution

- **NG 4SLB Engines** (96% populated)
  - 0-499 HP: 139
  - 500-999 HP: 170
  - 1000-4999 HP: 608
  - 5000-10000 HP: 37

- **NG 2SLB Engines** (93% populated)
  - 0-499 HP: 323
  - 500-999 HP: 261
  - 1000-4999 HP: 506
  - 5000-10000 HP: 56

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Further Subcategorizing 4SRB

- 0-250 HP 6.2% catalytic reduction >250 HP 27.5% catalytic reduction
- 0-475 HP 11.2% catalytic reduction >475 HP 29.0% catalytic reduction
- 0-500 HP 11.5% catalytic reduction >500 HP 29.2% catalytic reduction

- 251-499 HP 22% catalytic reduction
- 101-250 HP 10% catalytic reduction
- 0-100 HP 1% catalytic reduction

- Database is Most Likely **Under-representative of Small Engines**

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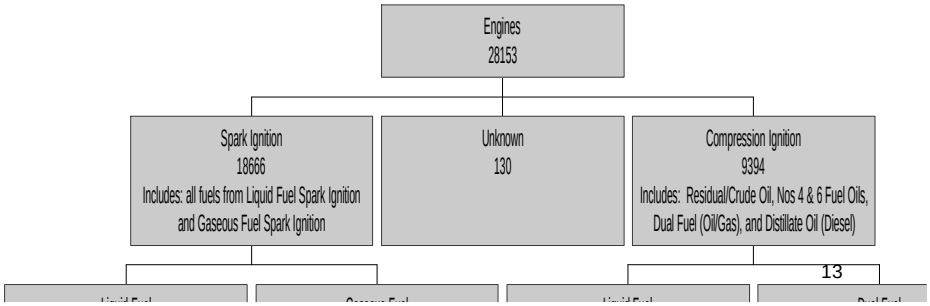
RICE Population Database

Total: 28,153



Database Representation

- **Compared the IC-Engines Population Database with:**
  - **API** data for oil and gas industry
  - **GRI** data for gas transmission industry
  - **AGA** directory of engines, turbines, and compressors
  - **OMS, PSR,** and **ACT** for industry wide information

- **API Data:**
  - 1996 statistical survey of onshore oil and gas field operations
  - SIC 1311 and 1321
  - All engines > 125 HP

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Database Representation

GRI Report:

- Retrofit NOx Control Technologies for Natural Gas Prime Movers, GRI 94/0329, 1994
- Population data based on 1989 AGA directory and computer database for engines used by the **Gas Pipeline Transmission Industry**
- Independent Surveys in 1986 and 1987
- Population data are estimated to account for **70% of the engines in use**

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Database Representation

AGA Directory for Engines, Turbines, and Compressors

- Engines, Turbines and Compressors Directory, XF0497
  1996 survey of all prime movers and compressors of 300 HP and greater

Office of Mobile Sources (OMS)

- Nonroad Engine Population Estimates, NR-006
- Based on PSR data and estimates of stationary versus mobile applications, Report by Booz, Allen, and Hamilton to CARB
- Population information for generators, pumps, compressors, and welders

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Database Representation

Power Systems Research (PSR)

- Incorporates engine sales including historical sales records, exports profile, and mean engine life
- Includes trucks, cars, buses, generator sets, air compressors, oil field equipment, refrigeration/AC, terminal tractors, forklifts, locomotives, power boats, mowers, tillers, etc. (>6 MM units)

Alternative Control Techniques (ACT)

- ACT Document -- NOx Emissions from Stationary Reciprocating Internal Combustion Engines, EPA-453/R-93-032, July 1993
- Total population estimated from annual production data and estimated average service life (1979 data)
- Includes 260,000 standby generators, 90,000 portable compressors, 50,000 small construction equipment, 63MM gasoline engines <15 HP, aircraft turbine starters, etc.

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Database Representation

Segment	API	CPR	ACA	OMS	ACT	PSR	ICCR
Oil and Gas Industry	1,150	NA	NA	NA	2,375	NA	1,038

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Database Representation

Conclusions:

API: Good representation of oil and gas industry

AGA: Good representation of gas transmission industry

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Preliminary MACT Floor

- No Controls At MACT Floor….EXCEPT
- Spark Ignition Natural Gas Fired 4 Stroke Rich Burn Engines (catalytic reduction)

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Control Technology

- **"Catalytic Reduction"** is the most common control device in the database

- **<u>"Catalytic Reduction" can be:</u>**
  - Non Selective Catalytic Reduction (**NSCR** or three way catalyst)
  - Selective Catalytic Reduction (**SCR**)
  - **Oxidation Catalyst** (CO-oxidation catalyst)

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Control Technology

- For Rich Burn engines, "Catalytic Reduction" refers to NSCR or Three Way Catalyst

- Simultaneously reduces NOx, CO, and HCs to N2, CO2, and water

- Verified through:
  - Texas Facilities: TNRCC
  - Catalyst Vendor: Engelhard
  - Literature review: ACT
  - WG members expertise

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Control Technology

- **Applicability:**
  - All **carbureted rich burn engines**
  - All **fuel-injected rich burn engines** with a suitable A/F controller
  - Fuels that do not contain masking or poisoning agents that can affect the catalyst control efficiency (NSCR are not recommended for landfill and digester gas engines)

- **NSCR is expected to be applicable to HAP control**
  - 90% control efficiency for HAPs. GRI, Emissions test results for a 2000 HP 4SLB engine with SCR. "Retrofit NOx Control Technologies for Prime Movers," p. 5-9.
  - NSCR will be tested in **WG's scheduled testing effort**

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Control Technology

- **For Lean Burn Engines, "Catalytic Reduction" refers to SCR or CO-oxidation catalyst**
  - SCR uses ammonia to convert NOx to N2
  - CO-oxidation converts CO to CO2

- **Verified through:**
  - Contacts Database Sources-mostly SCRs
    - Texas facilities: TNRCC
  - Contacts with catalyst vendor: Engelhard
  - Literature review
    - ACT
  - WG members expertise

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Control Technology

- **Applicability - SCR**
  - All **lean burn engines** (2 and 4 strokes)
  - Fuels that do not contain masking or poisoning agents that can affect the catalyst control efficiency (SCR are not recommended for **landfill and digester gas engines**. Oil fuels and refinery gases may also contain such agents)

- **SCR effectiveness for HAP control is unclear**
  - 26% reduction for HC
  - 89% reduction for toluene
  - 10% reduction for formaldehyde
- GRI, Emissions test results for a 2000 HP 4SLB engine with SCR. "Retrofit NOx Control Technologies for Prime Movers," p. 4-10.
- SCR will **not be tested** in the WG's testing efforts.

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Control Technology

- **Applicability - CO-Oxidation Catalyst**
  - All lean burn engines (2 and 4 strokes)

- **CO-Oxidation Catalyst may be applicable to IC Engines for HAP control**
  - CO-Catalyst will be tested in **WG's scheduled testing effort**

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Control Technology

- **Conclusions:**
  - **NSCR** is applicable for **HAP controls for rich burn** engines
  - SCR may be applicable to selected HAPs
  - CO-Oxidation Catalyst may be applicable for HAP control for lean burn engines
  - Control efficiencies of both catalysts will be determined during the WG's scheduled testing efforts

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Presentation Summary

- Updated On Work Activities
- Database Representation
- Propose "Preliminary MACT Floor"
  - NSCR for Natural Gas 4SRB engines
  - No add-on controls for all others
- Control Technologies

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ATTACHMENT VI

NATURAL GAS TRANSMISSION INDUSTRY CONCERNS ABOUT THE USE OF THE EPA ICCR POPULATION DATABASE FOR RECIPROCATING INTERNAL COMBUSTION ENGINES AS THE BASIS FOR THE PRELIMINARY MACT FLOOR DETERMINATION FOR NATURAL GAS-FIRED ENGINES

Natural Gas Transmission Industry Concerns About the Use of the EPA ICCR Population Database for Reciprocating Internal Combustion Engines as the Basis for the Preliminary MACT Floor Determination for Natural Gas-Fired Engines

February 26, 1998

The natural gas transmission industry representatives from INGAA and A.G.A. are concerned about the use of the EPA ICCR Population Database to determine the preliminary MACT floor for natural gas-fired engines.

The INGAA\A.G.A. representatives have submitted comments on the Population Database during Work Group meetings and via e-mails to the EPA contractor, Alpha-Gamma. As a result of the INGAA\A.G.A. comments, the Population Database has been improved -- turbines and other misclassified units have been removed from the database, more natural gas-fired units have been subcategorized, and more accurate size information has been added to the database. However, the database still has the following problems:

- **Too few units are subcategorized to determine a representative MACT floor. Although there are more than 17,000 natural gas-fired engines in the Population Database, only 21% of those engines (about 3,700) are subcategorized.**
- **The units that are subcategorized are not geographically representative of the population of IC engines in the United States. Although natural gas engines are included in the database for 45 States, only 1 State (New Mexico) has at least 50% of its engines subcategorized. Indeed 38 States have 20% or less of their engines subcategorized. (See Figures 1-4 attached.)**
- **The units that are subcategorized are more likely to be units with controls. For units with the control code "catalytic reduction," 43% of the units are subcategorized, whereas only 20% of units without the control code "catalytic reduction" are subcategorized.**

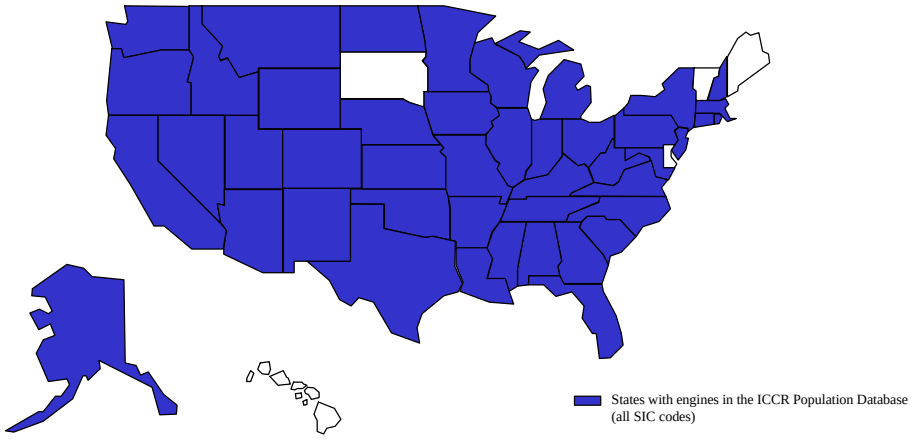
The problems noted above are true for the engines included in the ICCR Population Database for the natural gas transmission industry (SIC codes 4922, 4923, 4924) and for the total population of natural gas engines included in the ICCR Population Database.

We understand that the Population Database will be used to develop estimates of national impacts for the ICCR rulemakings and to develop model plants for IC engines. We also have concerns about the use of the Population Database for those purposes.

We request that these concerns be included in the EPA Docket along with any MACT floor findings that rely on the Population Database. In addition, we request that any presentation materials developed concerning the use of the

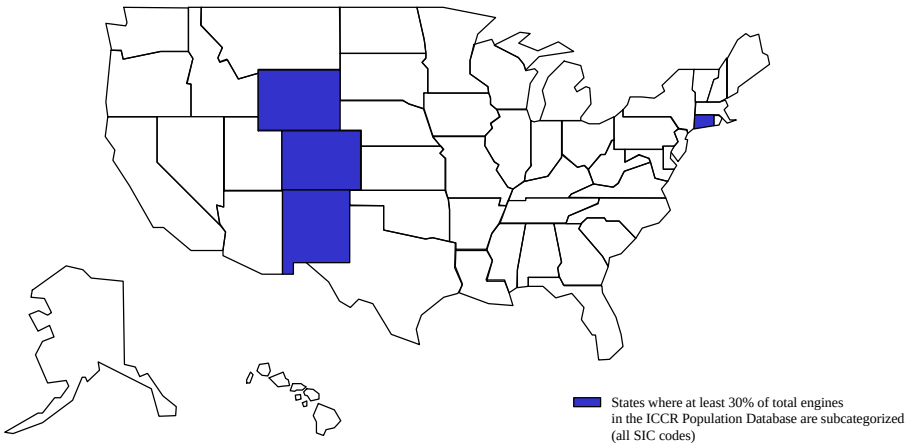
Population Database as the basis for the MACT floor include these concerns.

Figure 1
States with Engines in the EPA ICCR Population Database
(Natural Gas - No Subcategories -- all SICs)



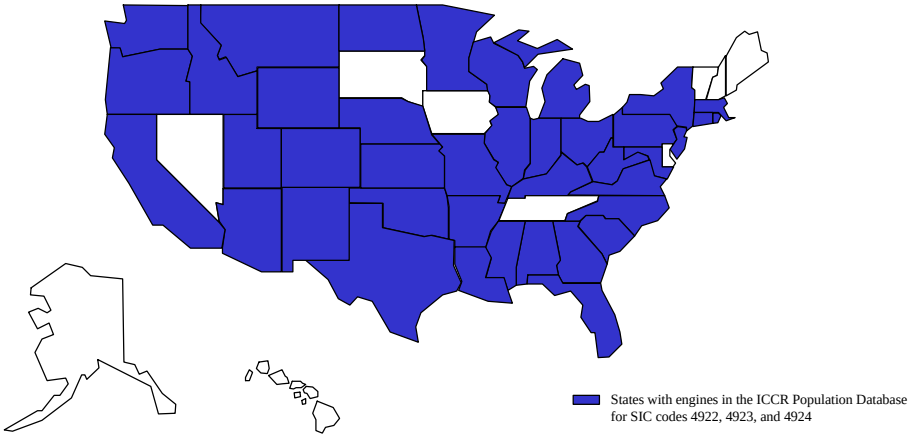
NOTE: This figure does not imply that States' engines included in the EPA ICCR Population Database are representative of the States' population of engines

Figure 2
States Where 30% or More of the Total Engines in the EPA
ICCR Population Database are Subcategorized
(Natural Gas - All Subcategories -- all SICs)



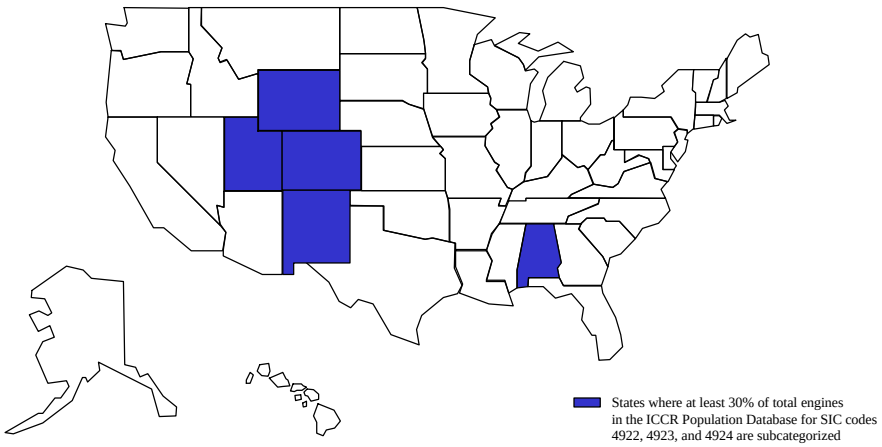
NOTE: This figure does not imply that States' engines included in the EPA ICCR Population Database are representative of the States' population of engines

Figure 3
States with Engines for SIC Codes 4922, 4923, and 4924
Natural Gas - No Subcategories



NOTE: This figure does not imply that States' engines included in the EPA ICCR Population Database are representative of the States' population of engines

Figure 4
States with Engines for SIC Codes 4922, 4923, and 4924
Where 30% or More of the Total Engines are Subcategorized
Natural Gas - All Subcategories



NOTE: This figure does not imply that States' engines included in the EPA ICCR Population Database are representative of the States' population of engines

ATTACHMENT VII

OTHER FUELS SUBGROUP PRESENTATION BY ED TORRES

Presentation on
“Other Fuels” for Engines

by Edward M. Torres

RICE Emissions Subgroup

February 5, 1998

Outline

1. Subgroup Objectives
2. Population Data
3. Available Source Test Data
4. Summary of Findings
5. Recommendations

Other Fuels Subgroup Objectives

- Review population data for other fuels engines
- Review availability of emissions test data
- Make recommendations on:
  - Need for additional source test data
  - Whether and how to regulate these sources
  - Subcategorization

Summary of Findings

- EPA database contains information on appropriately 1,200 “other fuels” for engines
- This represents approximately 4.5% of the 28,000 engine population
- Contains 11 known and 2 unknown fuel types
- Largest fuel source – gasoline makes up 40% of these engines
- Gasoline engines principally < 50 hp

Summary of Findings (cont'd)

- Only digester gas has enough information to estimate emissions
  - However, insufficient engine data available
- All sources, except possibly two, show no control for MACT floor
  - Landfill gas and residual/crude oil

Summary of Findings (cont'd)

- Landfill Gas
- 1997 EPA Survey shows fewer sources (89 vs 130)
- Industry sources question level of oxidative control reported in EPA database
- Dioxans/DiFurans: limited data available, mostly overseas
  - data shows trace levels present (90% less than 100 picograms/ft^3)

Recommendations

- No further testing for any fuels due to small population
- Subcategorize digester gas because of lack of data on successful add-on control application
- Remove landfill gas engines – regulate under separate Landfill MACT Standard

EPA Database:
Source Test Reports for Other Fuels

Fuel Type	Facility Type	Number of Test Points
Propane	Oil Company	1
Landfill Gas	Energy Company	1
Digester Gas	POTW	35

BREAKDOWN OF OTHER FUEL TYPES BY HORSEPOWER

FUEL TYPE	UNIT HP	NO.
Digester Gas	400 to 449	1
	Digester Gas Total	1
Gasoline	0 to 49	127
	50 to 99	7
	100 to 149	3
	150 to 199	2
	200 to 249	3
	250 to 299	2
	750 to 799	1
	1100 to 1149	1
	1350 to 1399	1
	1450 to 1499	1
	2400 to 2449	1
	3600 to 3649	1
	4000 to 4049	1
	59850 to 59899	1
	Gasoline Total	152
Kerosene/Naphtha (Jet Fuel)	0 to 49	2
	100 to 149	2
	150 to 199	1
	300 to 349	1
	500 to 549	1
	600 to 649	1
	650 to 699	1
	1100 to 1149	1
	1250 to 1299	1
	2200 to 2249	1
	2650 to 2699	1
	2750 to 2799	1
	Kerosene/Naphtha(Jet Fuel) Total	14
Landfill Gas	150 to 199	1
	500 to 549	1
	850 to 899	1
	1250 to 1299	1
	1750 to 1799	1
	2250 to 2299	1
	4500 to 4549	1
	Landfill Gas Total	7

FUEL TYPE	UNIT HP	NO.
Liquified Petroleum Gas(LPG)	0 to 49	2
	50 to 99	4
	100 to 149	3
	250 to 299	1
	350 to 399	3
	500 to 549	1
	550 to 599	3
	600 to 649	1
	650 to 699	1
	750 to 799	4
	850 to 899	1
	1200 to 1249	2
	1450 to 1499	1
	Liquified Petroleum Gas(LPG)Total	27
Process Gas	0 to 49	1
	150 to 199	2
	350 to 399	1
	1050 to 1099	1
	3100 to 3149	1
	Process Gas Total	6
Propane	0 to 49	1
	50 to 99	1
	250 to 299	1
	700 to 749	1
	6250 to 6299	1
	Propane Total	5
Residual/Crude Oil	450 to 499	1
	900 to 949	1
	1900 to 1949	1
	9350 to 9399	1
	9500 to 9549	1
	31550 to 31599	1
	44200 to 44249	1
	Residual/Crude Oil Total	7
	GRAND TOTAL:	**219**

ATTACHMENT VIII

SCHEDULE FOR TESTING PRESENTED BY BRYAN WILLSON

	Task	Respons.	Cost	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
1	Draft detailed project task list	Willson		••										
2	Testing subgroup review of detailed project task list	Test subgroup		••										
3	Complete detailed test plan	Test subgroup		••										
4	Statement of work prepared	EPA		••	••									
5	EPA contractor selected	EPA			υ									
6	EPA contractor under contract	EPA			••									
7	EPA contractor begins work	EPA				υ								
8	Project planning meeting	All	$2,500			υ								
9	"Education" of EPA contractor	WG, EECL				••••								
10	Contractor drafts work plans for subcontractors	EPA cont.				•••								
11	Subcontractors selected	EPA cont.				••								
12	Subcontractors under contract	EPA cont.					υ							
13	QAPP usage questions	TS - Coerr, Clowney		• •	• •									
14	QAPP - measurement statistics	TS - Martin, Willson		• •	• •									
15	Pre-test site visit:	EECL, TS, EPA, Prime cont, meas cont.	$12,000				υ							
16	Prepare QAPP	EPA contractor	$7,500				••••							
17	Prepare Site Test Plan	EPA contractor	$5,000				•••••••							
18	Select catalyst vendor(s)	TS			••••									
19	Work w/ vendor(s) to finalize catalyst selection	TS & Cat vend			••••									
20	Submit catalyst order - may require $$$					υ								
21	Catalyst manufacturing / canning	Cat vend	$20,000				r r r r	r r r r						
22	Submit "work order" to Cat for 3508	TS		υ										

23	Rebuild 3508 engine to WG specs	Caterpillar			r r r r	r r r r r	r r r r							
24	Design housing for diesel cat.	EECL					••••							
25	Order housing for diesel engine	E P A Contractor	$8,000				υ							
26	Manufacture cat. housing for diesel	Cat. vendor						r r r r	r r					
27	Ship 3508 to EECL	Cat	$2,000					••••						
28	Build skid & set 3508 engine	EECL	$10,000					••••	••••					
29	Extend env. controls to 3508 (temp, humid)	EECL	$7,500						••••	••••				
30	Dyno coupling, cooling, connections	EECL	$2,500							••••				
31	Install fuel transfer & meas. system	EECL	$5,000							••••				
32	Install catalyst housing for diesel	EECL	$2,500							••••				
33	Misc. instrumentation for 3508 engine	EECL	$10,000							••••	••••			
34	3508 shakedown	EECL	$5,000									• • • •		
35	Catalyst aging: 2-stroke (see cost calc.)	EECL	$22,255						LB2 age					
36	Testing of 2-stroke engine (see cost cal.)	EECL, TS, E P A , P r i m e cont, meas cont.	$78,403							LB2 test				
37	Review of testing procedures	EECL, TS, EPA, Prime cont, meas cont.								••••				
38	Catalyst aging: 4-stroke lean burn	EECL	$22,255								LB4 age			
39	Testing of 4-stroke lean burn engine	EECL, TS, E P A , P r i m e cont, meas cont.	$78,403								LB4 test			
40	Catalyst aging: 4-stroke rich burn	EECL	$19,268									RB4 age		
41	Testing of 4-stroke rich burn engine	EECL, TS, E P A , P r i m e cont, meas cont.	$78,403									RB4 test		
42	Catalyst aging: diesel	EECL	$24,308										D age	

43	Testing of 4-stroke diesel engine	EECL, TS, EPA, Prime cont, meas cont.	$93,403										D test	
44	Decommissioning, return of diesel	EECL	$5,000											••••
45	Report - data analysis	EECL	$20,000							••••	••••	••••	••••	••••
46	Report	EPA contractor	$40,000							••••	••••	••••	• • • •	• • • •
47	Project management - EECL	EECL	$10,000			• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
48	Project management - EPA contractor	EPA cont.	$20,000			• • • •	• • • •	• • • •	••••	••••	••••	••••	• • • •	• • • •
	Total Project Cost		#####											
	Project contingency / (overage)		($1,199)											

υ Milestone

r Waiting period

r

•• Indicates level & duration of effort

Notes:

8 Attendees: EPA, work group rep., EECL, contractor. Probably held at EPA, or conduct w/ Feb. mtg. if contact in place. Assume $2,500 for contractor expense / labor

9 Test plan, measurement techniques, EECL setup, etc.

15 See attached cost calculation. NOTE: All estimates for EPA & measurement contractor are **very rough;** no input from EPA or contractor,

21 Cost may be reduced or eliminated if catalyst manufacturer donates

25 Catalyst maker contracts this out, possibility of 50% cost share

29 Temperature & humidity controls

33 Note: the instrumentation package proposed here is pretty "bare bones" compared to what we do on the gas engines where there were much larger installation budgets. The controls for the diesel will not be as integrated or as automated as for the gas engines. We should probably discuss.

35 Costed as 1 day run time + 1 day testbed maint + 1 day equip. capital / 24 hours

No complete data points during aging, but will record pre- and post-catalyst FTIR data during aging: THC, CO, CO2, NOx, CH2O + other FTIR HAPs

Will allow trending of catalyst efficiency vs. time during aging to ensure that catalyst has aged sufficiently.

36 Assumes 1 setup day, 4 days of testing, normal allowance for some re-test. Should explore cost-effectiveness of simultaneous sampling for non-FTIR components as well.

42 Diesel aging more expensive due to higher fuel cost

43 Diesel testing more expensive due to higher fuel costs and cost of additional analysis: particulates, fuel metals, etc.
Only $5,000 has been budgeted for dilution / particulate measurement system. Assumes one can be borrowed from Sierra / U. of Wisc.
On a side note, dilution will reduce the HAPs concentration and increase measurement uncertainty. Can we dilute just for particulates?

44 Unless Caterpillar allows engine to stay at EECL

45 Will deliver reduced data tables in spreadsheet form. All other data kept on file at EECL (calibration sheets, raw data sheets, cyl. pressures, etc.)

47 Cost of planning / supervision for EECL's Large Engines Project Manager

Misc. notes

- Timeline assumes that contracts are in place by dates shown. Delays in contractual process could result in project delays.
- No consultation has occurred in regard to fees / expenses for the EPA contractor or the measurement contractor.
  It is very possible that expenses for the EPA contractor & measurement contractor could be much higher.
- Does not incorporate additional expenses of onsite QC testing if required by EPA contractor
- Calibration gases for criteria pollutants used are Scott™ single-certified Accublend™ "master gas" designation, *not* certification gases
- Field aging of catalysts was considered, but will incur significant expenses for site selection, negotiation, separate site visits and field testing during aging, & proj. management.
  Field aging must ensure the compatibility of housings between field site & EECL test engines; control of conditions difficult.
- This budgetary exercise is for planning purposes only and does not constitute a proposal on the part of the EECL.
- EECL lab fees are at audited & established rates, except for discounted aging rate.
  EECL labor charges are for EECL staff only. No fees are charged for Willson's participation.
- If desired, can scrub water & CO2 and examine BTEX components with FTIR, would add $3,000-$5,000 for scrubber installation

ATTACHMENT IX

TERRY HARRISON’S PRESENTATION ON CONTRACTOR FOR TESTING

Status of EPA Test Program

We have a prime contractor (PES)
We're about on the schedule posed by Bryan
We are proceeding on the assumption that the tasks will need to be done, what must remain very hazy for now is who will do them and how they will be paid
There may be a budget shortfall

Sources of potential shortfall

EPA Budgeted $610,000
Did not anticipate
Obtain & Install Catalyst (21,25)$28,000
Catalyst Aging (35,37,39,41)---$88,000
Ship & Decom engines (27, 43)-$7,000
Extend test site/equip (28-34)- $42,500

Why it must remain hazy

I have to follow Federal Acquisition Regs
EPA has an independent contracts management group that assures EPA follows the contract rules
In fact they are the only ones who can legally obligate EPA funds - I have to convince them to spend our money

Next Steps

Assuming there is a shortfall, EPA will either need to scale back the test program or commit more EPA money
Other stakeholders can offer assistance. (EPA is not soliciting.) Contractually, it's easier if specific tasks are funded.

ATTACMENT X

NEXT STEPS PRESENTATION BY SAM CLOWNEY

Next Steps Ad-Hoc Group Report on Above-the-Floor MACT

presented to:

Reciprocating IC Engine Work Group

presented by:

Sam Clowney, Tennessee Gas Pipeline

February 26, 1998

Topics

- Possible Approach to Above-the-Floor MACT
- Model Engines for Above-the-Floor MACT
  - Engine characteristics
  - Criteria for inclusion/exclusion of engine characteristics
- Possible Next Steps for this Ad-Hoc Group

Possible Approach to Above-the-Floor MACT

1. Review above-the-floor control alternatives for subcategories identified thus far
2. Use model engines to represent the existing population of engines
3. Determine costs for controls on model engines
4. Develop baseline emission estimates for HAPs
5. Develop control device efficiency estimates for HAPs
6. Determine costs per ton of HAPs removed
7. Evaluate above-the-floor scenarios and determine size/emissions cutoffs

Above-the-Floor Considerations

- Other benefits of control alternatives
- Cost elements for cost-effectiveness evaluation
  - Capital & installation costs
  - Annual operating costs
  - Costs for monitoring
  - Costs for recordkeeping and reporting
- Criteria for cost-effectiveness

Model Plants

- Strategy: take a look at what Turbine Work Group did
  - Turbine characteristics to describe & differentiate model turbines
  - Criteria for inclusion/exclusion of turbine characteristics in model turbines
- Goal for IC Engine Work Group at this Meeting:
  - Mark up Turbine Work Group materials to develop:
    - » Preliminary List of Engine Characteristics
    - » Preliminary List of Criteria for inclusion/exclusion of engine characteristics in model engines

Criteria for Inclusion/Exclusion

1. Will the characteristic impact the feasibility of applying controls

2. Will the characteristic significantly impact the cost of applying controls

Possible Next Steps for this Ad Hoc Group

- Finalize preliminary list of engine characteristics
- Finalize preliminary list of criteria for inclusion or exclusion of engine characteristics in models
- Develop list of preliminary engine models
  - make & model, size, hours of operation, industry or application
- Test representation of list of preliminary engine models against ICCR Population Database

Possible Next Steps for this Ad Hoc Group

- Model Plants
  - Finalize preliminary list of engine characteristics
  - Finalize preliminary list of criteria for inclusion or exclusion of engine characteristics in models
  - Develop list of preliminary engine models
    - » make & model, size, hours of operation, industry or application
  - Test representation of list of preliminary engine models against ICCR Population Database
- Costs
  - Develop cost estimates for model engines

Next Steps

1. **Finalize preliminary subcategories -- write descriptions of each subcategory & substantiate technical reasons for different subcategories. These would include, at a minimum:**
   - **Natural gas**
     - **2-stroke lean burn**
     - **4-stroke rich burn**
     - **4-stroke lean burn**
   - **Digester Gas/Landfill Gas**
   - **Diesel**
   - **Other liquid fuels (to be listed for Work Group review)**
   - **Other gaseous fuels (to be listed for Work Group review)**

2. **Finalize preliminary MACT floor for all fuels, based on available information. INGAA\A.G.A. concerns about the problems in the database are to be included with any MACT floor finding. Presentation materials regarding the use of the database for MACT floor to include the INGAA\A.G.A. concerns.**

3. **Document results of Work Group's analysis of possible HAP control devices, by subcategory, including:**
   - **Control codes included in the Population Database, and**
   - **Control techniques included on Don Dowdall's subcategory handout (July'97)**
   - **Other relevant controls**

4. **Develop presentation for April '97 Coordinating Committee meeting that provides the following information for the CC:**

   a) **Preliminary subcategories**

   b) **Results of HAP control device review**
      - **Possible HAP emission controls under evaluation for natural gas-fired engines: oxidation catalysts for lean burn engines and NSCR for rich burn engines -- discussion of theoretical effect on select HAPs -- not all HAPs affected**
      - **Possible HAP emission controls under evaluation for diesel-fired engines: oxidation catalysts -- discussion of theoretical effect on select HAPs -- not all HAPs affected**
      - **Possible HAP reduction strategies under evaluation for**
        - **digester gas engines**
        - **other gaseous fueled engines**
        - **other liquid fueled engines**

   c) **Preliminary MACT Floor for all subcategories, based on available information, and including INGAA\A.G.A. concerns about ICCR Population Database for gas-fired engines**